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Development of an Ionization Profile Monitor for the Spallation Neutron Source Accumulator Ring

The Spallation Neutron Source (SNS) located in the Oak Ridge National Laboratory has strict beam loss limitations to ensure machine protection and low radiation levels required for maintenance. In order to reach the 1.4 MW design beam power, diagnostic tools with the ability to measure transverse beam profiles in the SNS Accumulator Ring are important for turn-by-turn beam optimization. An Ionization Profile Monitor (IPM) is one solution to this problem. An IPM uses a static electric field perpendicular to the beam direction to accelerate ions, created by the beam as it passes through the residual gas in the beampipe, to a detector located at the bottom of the beampipe. The signal amplitude from the detector is directly proportional to the ion density which in turn is proportional to the beam density, therefore, providing a non-intrusive method of profile measurement. It is the goal of this research to analyze and design a non-destructive profile monitor by using electrons to make fast, broadband measurements. With an accuracy, when compared to simulations and destructive profile measurements, of 10%, when sampled over multiple turns, the SNS IPM will be unique in its implementation of a high bandwidth design and electronics to resolve turn-by-turn beam dynamics with rise times on the order of 10 ns. Furthermore, designed with ability to generate profiles using ions, the SNS IPM will allow for the comparison of profile generation techniques.